

## Significant Accomplishments

## HIGHLIGHTS OF MAJOR RISK-INFORMING INITIATIVES

The following paragraphs highlight the major risk-informing initiatives that either the staff has completed over the past six months or are scheduled to be conducted over the next six months.

1. **Fire Protection for Nuclear Power Plants:** The staff continues its effort on fire protection. The following summarizes the past and planned accomplishments in this area:
  - The staff completed the rulemaking to endorse an alternative performance-based and risk-informed fire protection rule for operating nuclear power plants. The final rule incorporated National Fire Protection Association (NFPA) Standard 805, "Performance-Based Standard for Fire Protection for Light Water Reactor Electric Generating Plants," into 10 CFR 50.48. Since the U.S. Nuclear Regulatory Commission (NRC) issued Regulatory Guide 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants," in May 2006, 40 operating nuclear power plants have indicated a desire to adopt this alternative rule.
  - During the past six months, as part of the NFPA 805 implementation process, the staff conducted observation visits to the pilot plants and conducted a number of public meetings. As part of this process, the staff plans to issue a Regulatory Information Summary (RIS) to communicate resolution of emerging issues identified and resolved during the NFPA 805 pilot implementation process. The staff also plans to revise the enforcement discretion policy for NFPA 805 transition plants and to conduct at least one workshop for regional inspectors.
  - In the area of fire modeling, the Advisory Committee on Reactor Safeguards (ACRS) recommended that NUREG-1824, "Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications," be published. The staff plans to issue it by May 2007. The staff has initiated the next phase of the fire modeling project which will be a joint project with Electric Power Research Institute to develop a fire model user's guide for nuclear power plant applications. A fire model Phenomena Identification and Ranking Technique meeting is also planned for the Summer of 2007. The staff has completed testing and analysis for the Cable Response to Live Fire (CAROLFIRE) project which supports the resolution of technical areas identified in NRC RIS 2004-03, Revision 1, "Risk-Informed Approach for Post-Fire Safe-Shutdown Circuit Inspections." The draft NUREG/CR reports are expected to be issued in May 2007, for a 45-day public comment period.
2. **Standardized Plant Analysis Risk (SPAR) Model Development Program:** The staff is developing plant-specific probabilistic risk assessment (PRA) (known as SPAR models) that model accident sequence progression, plant systems and components, and plant operator actions. These models are easy-to-use tools that enable the NRC staff to perform risk-informed regulatory activities by independently assessing the risk of events or degraded conditions at operating nuclear power plants. The following summarizes the past and planned accomplishments in this area:

- SPAR models for internal initiating events during full-power operation are available for all 72 plant sites in the United States. The staff is currently developing models for external initiating events (fires, floods, seismic events, high winds, etc.). Two Level 2 models are being developed and evaluated as part of a proof-of-concept to support other agency initiatives.
  - The staff is currently using SPAR models to support the development of the state-of-the-art reactor consequence analysis of severe accidents at nuclear power plants.
  - The staff is developing a Browns Ferry 1 SPAR model to be completed in August 2007.
  - The staff has begun discussions with industry in an effort to resolve several generic technical issues that influence both SPAR and licensee PRA quantification results.
3. **Digital Systems PRA:** The staff is developing guidance on integrating risk insights into digital system reviews and comprehensive guidance for risk-informing digital system reviews. In March 2007, the staff published a NUREG/CR on “Dynamic Reliability Modeling of Digital Instrumentation and Control Systems for Nuclear Reactor Probabilistic Risk Assessments.” The report illustrates how the dynamic models, Markov modeling, and dynamic flowgraph modeling, can be developed and integrated into PRAs. This report is one part of the overall NRC effort to advance the state-of-the-art in digital system risk and reliability modeling to the point where it will be possible to risk-inform licensing reviews for digital systems.
4. **Risk Management of Technical Specifications (RMTS):** The staff continues to work on the RMTS initiatives to add a risk-informed component to the standard technical specifications. The following summarizes the major accomplishments in this area:
- Initiative 1, “Modified End States”: This initiative would allow (following a risk assessment) some equipment to be repaired during hot shutdown rather than cold shutdown. The topical reports supporting this initiative for both boiling water reactor and Babcock & Wilcox plants have been approved. The Westinghouse topical report, submitted September 2005, is under review.
  - Initiative 4b, “Risk-Informed Completion Times”: The overall objective of this initiative is to modify technical specifications (TS) to reflect a configuration risk management approach that is more consistent with the approach of the maintenance rule in Title 10, Section 50.65(a)(4), of the Code of Federal Regulations (10 CFR 50.65(a)(4)). Draft industry guidance and pilot plant applications are undergoing review. The South Texas Project and Fort Calhoun Station pilot plants reviews are to be completed in FY 2007.
  - Initiative 6, “Modification of Limiting Condition for Operation (LCO) 3.0.3, ‘Actions and Completion Times’”: A revised Combustion Engineering (CE) topical report will be submitted late spring 2007, for staff review. This topical report will support a future revision to the CE Standard TS to incorporate this initiative.

- Initiative 7, “Non-TS Support System Impact in TS System Operability”: This initiative would permit a risk-informed delay time before entering LCO actions for inoperability attributable to a loss of support function provided by equipment. Guidance documents have been approved for snubbers and hazard barriers and the industry is preparing additional proposals.
5. **Risk-Informed Decision-Making:** Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-504, “Integrated Risk-Informed Decision Making for Emergent Issues,” was developed to address recommendations raised by the Government Accountability Office report [GAO-04-415, “Nuclear Regulation—NRC Needs to More Aggressively and Comprehensively Resolve Issues Related to the Davis-Besse Nuclear Power Plant’s Shutdown,” issued May 2004]. A revision to LIC-504 was issued on February 12, 2007, to incorporate comments from pilot applications of revision 1. In the next six months, the staff will conduct training on LIC-504 for the NRR Executive and Leadership Teams.
  6. **Risk-Informed Environment:** In December 2006, the staff issued an action plan entitled “Fostering a Risk-Informed Environment in Nuclear Reactor Regulation.” This plan outlined five major actions designed to broaden staff knowledge and application of risk insights in its day-to-day activities. These actions relate to staff qualification plans and training, first-line supervisor risk knowledge, and knowledge management tools. Over the last six months, two actions have been completed. The staff added a unit on risk-informed regulation to office qualification plans and created a web-based forum for knowledge management on risk-informed regulation. An interoffice PRA Training Focus Group will develop an initial draft of new basic courses on risk-informed regulation for managers and non-PRA technical staff. These courses are expected to be piloted in the fourth quarter of FY 2007.
  7. **Phased Approach to PRA Quality:** A key part of implementing the phased approach is the development of PRA standards and related guidance documents. The increased use of PRAs in the NRC’s regulatory decision-making process requires consistency in the quality, scope, methodology, and data used in such analyses. To achieve this objective, professional societies, industry, and the staff have undertaken initiatives to develop national consensus standards and guidance on the use of PRA in regulatory decision-making. Based on updates to the standards and guidance documents issued by the American Society of Mechanical Engineers (ASME) and the Nuclear Energy Institute, the staff issued in January 2007 Revision 1 to Regulatory Guide 1.200, “An Approach for Determining the Technical Adequacy of PRA Results for Risk-Informed Activities.” Revision 1 to Regulatory Guide 1.200 is an important step in the phased approach to PRA quality, because it removes the designation of that Regulatory Guide as “for trial use.” The staff participated in an industry workshop (March 27-29, 2007) on Revision 1 of Regulatory Guide 1.200, which covered licensing impacts, process considerations, regulatory positions, and technical issues associated with removing the “for trial use” designation from that Regulatory Guide. Future revisions of Regulatory Guide 1.200 will address PRA quality standards for fire, external events, and low power and shutdown operations risk assessments.

Also in the last six months, the staff participated in ASME votes on risk-informed ASME code cases. In the upcoming six month period, the staff plans to issue revisions to Standard Review Plan, Chapter 19, “Probabilistic Risk Assessment and Severe Accident Evaluation,” to address new reactors, and to issue Regulatory Guide 1.206, “Combined License Application for Nuclear Power Plants (LWR edition).”

8. **Risk-Informed Rulemaking:** Risk-informed rulemaking activities include changes to 10 CFR 50.46, changes to 10 CFR 52, and soliciting stakeholder interest in a risk-informed and performance-based Part 50, to be designated as 10 CFR 53. These are discussed below.
- Changes to Technical Requirements of 10 CFR 50.46: This rulemaking is to redefine the large break loss-of-coolant accident requirements to provide a risk-informed alternative maximum break size. The staff prepared a proposed rule containing emergency core cooling system evaluation requirements as an alternative to those specified in 10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems (ECCS) for Light-Water Nuclear Power Reactors," which could be used in lieu of the current requirements in 10 CFR 50.46. Since October 2006, the staff produced a draft final rule and briefed the ACRS. The ACRS recommended that the proposed rule not be issued in the current form. The staff will provide a SECY paper to the Commission with a plan for responding to ACRS comments on the proposed change to 10 CFR 50.46, including resource and schedule estimates.
  - In 2005, the staff completed the development of the technical basis necessary to support a risk-informed rulemaking effort to modify the pressurized thermal shock screening criteria in 10 CFR 50.61. This technical basis was reviewed at various stages by NRC's external stakeholders, a select external peer review panel of technical and regulatory experts, the ACRS and NRC technical staff. In July 2006, the technical basis reports were made available to the public and the reports were published in final form in December 2006. This rulemaking concludes with provision of a revised version of 10 CFR 50.61 for Commission approval in January 2008.
  - The staff received and evaluated public comments on the Advanced Notice of Proposed Rulemaking (ANPR RIN 3150-AH81) regarding whether to make a risk-informed and performance-based revision to 10 CFR Part 50 (10 CFR 53). The staff will provide the Commission with a recommendation on whether to proceed with rulemaking in May 2007.
9. **External Communications on PRA:** The staff is developing a range of communication approaches to reach the agency's diverse body of stakeholders. Over the last six months, three actions have been completed. The staff revised Office of Public Affairs (OPA) fact sheets on "Nuclear Reactor Risk" and "Probabilistic Risk Assessment." Such fact sheets are publicly available and OPA commonly uses them as reference material to respond to questions from the media and other stakeholders. Additionally, the staff developed a public-outreach brochure on risk-informed regulation and transmitted it to OPA for review and further development.

Over the next six months, the staff expects to implement a revision to the NRC public Web site to make information on the purpose and use of PRAs and risk-informed activities easier to find and more understandable to stakeholders. The staff is updating the redesign to include performance-based elements.

- 10. Develop Improved Human Reliability Analysis (HRA) Methods for Calculating Risk in Support of Risk-Informed Regulatory Decision-Making:** Currently, there are many HRA methods available for use in risk-informed regulatory applications. The ACRS has made specific recommendations on the need to compare the fundamental assumptions behind NRC models as well as the NRC and industry HRA models. Furthermore, the Commission directed the ACRS to “work with staff and external stakeholders to evaluate the different Human Reliability models in an effort to propose either a single model for the agency or guidance on which models should be used in specific circumstances.”

As a result of these interactions, the staff initiated work for testing HRA methods using empirical data. The results of this study will be used to better assess the accuracy, strengths, and weaknesses of the various HRA methods in order to create a tool box of HRA methods.

This study will be conducted with the collaboration of the Halden Reactor Project and its signatory organizations. Halden is offering its simulator facilities to perform the simulator runs and collect the data. About a dozen domestic and international organizations will participate in the study. Currently, a “Pilot” of the study is being conducted with the objective of testing the experimental methodology, which expected to be completed by September 2007.

- 11. Incorporating Risk Information into the High Level Waste Regulatory Framework:** The Yucca Mountain Review Plan (NUREG-1804, Rev 2, 2003) provides guidance to the staff on implementing the risk-informed, performance-based regulations of 10 CFR Part 63. The staff will use the Yucca Mountain Review Plan to ensure that licensing reviews are risk-informed and the proper level of effort is focused on areas important to the safety of the potential geologic repository at Yucca Mountain, Nevada.

Using risk insights, Model Abstraction Review Team strategies were developed and completed in March 2007. Total System Performance code, version 5.1 is scheduled to be developed for June 2007.

- 12. PRA of Dry Cask Storage Systems:** In support of the Commission’s policies on risk-informing the regulatory process and performance goals, the staff developed PRA methods and quantified the risk associated with dry cask storage of spent nuclear fuel. This study provided (a) methods to quantify the risk of dry cask storage of spent nuclear fuel, (b) insights into decision-making on how to improve regulatory activities associated with 10 CFR Part 72, “Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste,” and (c) analytical tools that can be used to implement future waste safety goals and risk-informed regulatory activities. The study has been completed and documented in NUREG-1864, “A Pilot Probabilistic Risk Assessment of a Dry Cask Storage System at a Nuclear Power Plant.” Insights gained from the report are being applied to the review and revision of the dry cask storage SRP and to the dry cask storage inspection program in the near future.
- 13. RAMQC Inspections:** On July 19, 2005, NRC issued Orders to NRC and Agreement State licensees imposing additional security measures (ASMs) with respect to the transportation of radioactive material quantities of concern (RAMQC). A risk-based approach was used in developing the RAMQC ASMs. The Orders apply to shipments of

radioactive materials in quantities greater than or equal to the Category 1 values in the International Atomic Energy Agency Code of Conduct on the Safety and Security of Radioactive Sources (Code). Category 1 is the most risk significant category in the Code. The Orders also apply to spent nuclear fuel shipments greater than 27,000 curies but less than 100 grams of material. The RAMQC requirements are more stringent than the transportation security requirements for smaller quantities of radioactive material. The RAMQC Temporary Instruction was issued on September 18, 2006. One hundred forty nine licensees have implemented the RAMQC Orders. Inspections of these licensees have begun and are expected to be completed in the latter part of 2007.

14. **Design Basis Threat:** On March 19, 2007, the NRC published the final rule for the design basis threat in 10 CFR 73.1. This rule requires licensees to establish and maintain a physical protection capability that provides high assurance that public health and safety will be protected should the facility be threatened by an adversary. The physical protection regulatory regimen allows licensees flexibility to develop risk informed defensive strategies to protect the most risk significant nuclear equipment from the design basis threat.

The inspection of the licensee defensive strategies is risk-informed and performance-based. Force-on-force exercises are conducted wherein the licensee defends against a simulated threat to demonstrate the ability to protect risk significant nuclear safety equipment. The significance determination process for inspection findings is risk-informed in that the significance of any physical protection failure is stratified by the effect the failure would have had on public health and safety had the exercise been actual. The overall regulatory regimen focuses on protection of risk significant equipment and verification through performance based inspection.

15. **Emergency Action Levels for Advanced Passive Light Water Reactors:** The NRC staff is performing a review of the industry developed draft emergency action levels (EALs) for advanced reactors. The staff is working with industry to ensure the EALs address potential advanced reactor accidents in a risk informed manner. EALs are used to declare one of four classes of emergency in response to events at nuclear power plants. The EALs and the resulting emergency response are stratified according to the risk significance of the event. The staff has previously endorsed risk informed EAL schemes for the current fleet of operating reactors and the intention is to endorse the advanced reactor EALs for use in emergency plans when staff concerns are fully addressed in the next six months.